CHARACTERISTICS OF SOLITARY WAVE IN FIBER BRAGG GRATING

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To all the beloved person in life especially
Mama, Papa, abg boby, abg wawan, saidah.

The difference between a successful person and others is
not a lack of strength, not a lack of knowledge,
but rather a lack of will.
When the world says ‘give up’,
hope whispers ‘try it one more time’

To my dearest friends:
Wondergirl UTM, Wondergirl Trans, Malayaparkers,
There are no limits to our possibilities.
Thank you for always supporting me.

To teachers:
Dr Saktioto and Prof Jalil,
I am indebted to my father for living,
but to my teacher for living well.

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ABSTRACT

In this study, nonlinear parameters are characterized in terms of the potential energy. This study investigates the photon energy of soliton propagating in a fiber Bragg grating (FBG). The formation of potential well of bright soliton in FBG is performed under Bragg resonance condition. In the presence of Kerr- nonlinearity, using the coupled-mode theory, the nonlinear coupled mode equation is defined. The existence of bright soliton is simulated in the FBG. This is done by applying the equation of bright soliton to the potential well. The results are obtained using MatLab software version R2010a. The nonlinear parameter in this study is initially set to $\alpha = 1.0$, $\beta = 0.7$ and $\gamma = 0.1$. The simulation of potential energy distribution throughout the grating is examined by varying the value of nonlinear parameters of α. The changes of nonlinearity parameter depends on the motion of photon in the potential well. This influences the existence of bright Bragg soliton in FBG. The couple mode theory and Stokes parameter provide important information on the total energy and energy differences between the forward and backward propagating modes. The propagation of pump signal and probe signal is investigated in order to monitor photon trapping with soliton. By applying Split Step Method on nonlinear Schrodinger equation (NLSE), the input and output pulse of the wave are obtained for different Fast Fourier Transform (FFT), window size and step size. The associated Legendre equation is applied to the probe equation and solving soliton interaction equation. From the photon trapping profile, it is shown that photon can be trapped in certain time by soliton.

ABSTRAK

Dalam kajian ini, ciri-ciri parameter tak linear bagi gelombang soliton dikaji dari segi tenaga keupayaannya. Kajian ini menyiasat tenaga foton dalam soliton di dalam gentian parutan Bragg (FBG). Pembentukan soliton cerah di dalam FBG dilakukan di bawah keadaan resonan Bragg. Dengan kehadiran kesan tak linear-Kerr, menggunakan teori mod pengganding, persamaan linear mod bersama ditakrifkan. Simulasi berjaya menunjukkan kewujudan soliton terang dalam FBG. Ini telah dilakukan dengan menggunakan persamaan gelombang terang bersendirian dan menghasilkan graf perigi keupayaan. Keputusan telah diperolehi dengan menggunakan perisian Matlab versi R2010a. Parameter tak linear dalam kajian ini pada mulanya ditetapkan α = 1.0, β = 0.7 and γ = 0.1. Simulasi agihan tenaga keupayaan seluruh gentian parutan diperolehi dengan mengubah nilai parameter tak linear α. Perubahan parameter tak linear bergantung atas pergerakan foton dalam perigi keupayaan tenaga. Ini mempengaruhi kewujudan soliton terang Bragg di dalam FBG. Teori pasangan mod dan parameter Stokes menyediakan maklumat penting mengenai perbezaan tenaga dan jumlah tenaga antara mod pergerakan ke hadapan dan ke belakang. Kajian ini juga menyiasat perambatan isyarat pam dan isyarat probe bagi memantau pemerangkapan foton oleh soliton. Dengan menggunakan kaedah Langkah Split pada persamaan Schrodinger tak linear (NLSE), nadi input dan output gelombang telah diperolehi untuk transformasi Fourier cepat, tetingkap saiz dan saiz langkah yang berbeza. Persamaan Legendre bersekutu juga digunakan untuk menyelesaikan persamaan interaksi soliton. Graf pemerangkapan foton telah menunjukkan bahawa soliton boleh memerangkap foton dalam masa tertentu.